

## 15.

A Parasitological Survey of Wild Rats in the  
New York Zoological Park.

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The control of wild rat populations in zoological parks throughout the world apparently is a universal problem. At times large scale poisoning and trapping become necessary to curb this pest which is attracted by the scattered food in the animal pens and the more or less rugged and natural wild surroundings in zoological parks within an otherwise urban community. Several of the keepers at the New York Zoological Park from time to time shoot rats which become a nuisance in the runs of the animals under their care. Many of these rats have been brought to the laboratory for postmortem examination. The author is particularly indebted to Mr. J. Gerben for his cooperation in this survey.

Parasites have been shown by many workers in the past to be very common in rats. Surveys of parasitism in rats killed within the Philadelphia Zoological Garden have been pursued for a number of years. In their annual Report of the Laboratory and Museum of Comparative Pathology for 1926 the question was raised of the importance of rats as transmitters of parasites within the collection. In 1929 Dr. Henry Winsor began to examine rats and mice killed in the Garden and his findings have been tabulated annually since that date. His reports are very general and brief and he records a much lower prevalence of parasites than most other workers have observed. According to his reports one would conclude that intestinal cestodes are rare in the rats in the Philadelphia Zoological Garden. *Capillaria hepatica* was the most common but apparently had never been observed in more than 30% of the rats examined in any one year. No blood parasites are included in Dr. Winsor's reports. More than 300 rats were examined for several of these reports.

In an examination of 2,500 adult *Rattus norvegicus* in Baltimore, Maryland, Luttermoser (1936) reported more than 97% infected with helminths. Andrews & White (1936), in an examination of the same group of 2,500 rats reported by Luttermoser, found 33.3% infected with protozoon parasites. Their investigation included an intensive search for protozoa in the intestine as well as blood smears. They reported 7.4% positive for *Trypanosoma lewisi* but only one rat with *Hepatozoon muris* in a blood smear. Price & Chitwood (1931) examined 100 rats caught in Washington, D. C., and found *H. muris* in 17%.

Rodents in a zoological collection are susceptible to some of these parasites. There is also the chance that other groups of animals may become infected with the rat parasites. *Cysticercus fasciolaris* occurs in the liver of rats as a developmental form of *Taenia taeniaeformis* which reaches maturity in the intestine of cats. Blood parasites of rats may also be transmitted to other animals. *Hepatozoon muris* has been reported from several species of

rodents. While *Trypanosoma lewisi* has been reported only from rats there has been very little investigation to test its host-specificity. A great many species of trypanosomes have been reported from a large variety of rodents; the parasites have the same morphology as *T. lewisi* but have not been as extensively studied. To what extent wild rats in a zoological park may be a menace as a source of parasitic infestation of the animals in the collection is not known. It was with the hope of shedding some light on this question that the present survey was begun. As yet no conclusions can be drawn since this survey can only give us an inkling of a part of one side of the picture. More data must first be obtained from examination of the animals in the collection. It is hoped that this investigation will be continued and extended in the future and perhaps aid in an evaluation of the status of the wild rat as a disseminator of parasites to confined animals in exhibit parks.

#### METHODS OF EXAMINATION.

The dead rats were brought to the laboratory and placed in the refrigerator until examination was made of the liver and the intestinal contents. Only parasites which could be seen on gross examination were collected. No smears were made from the intestinal contents and a microscope was not used when the parasites were collected. Thus, small parasites which could not be seen with the unaided eye have been overlooked.

The tapeworms and nematodes collected from the intestine were preserved for species identification. Blood smears were made from all the rats examined, stained with Giemsa's stain and then examined under the oil immersion objective of a compound microscope with a 5× ocular for at least five minutes to each smear. Fleas and mites were observed from time to time and a few of these were collected but the findings were not tabulated. Intensive collections in the past have been made of ectoparasites in connection with epidemiological investigations of typhus fever, plague and other diseases.

#### RESULTS.

The occurrence of parasites in the 200 rats (*Rattus norvegicus*) examined in this survey between July 20, 1938, and July 20, 1939, is tabulated in the accompanying table. The bottom column, "total number parasitized," represents the number of rats in which at least one of the parasites occurred. All of the species found, which included two nematodes, three cestodes and two protozoa, have been previously reported from rats in other surveys.

Of the forms found, *Capillaria hepatica* was the most common in both the adults and the young. The intensity of the infection with this parasite varied greatly in the group of rats examined. In most of the younger rats only a very small portion of the liver was involved, but in a few of the adults the characteristic yellowish masses of nematode eggs involved almost the entire area of the liver. In one such heavy case the examination of histological sections revealed a wide-spread regeneration of liver cells in the damaged areas. In the 129 *Capillaria* infections in the adult rats 14% could be termed heavy infections since they involved more than one-half of the liver's surface. None of the livers of the young rats were so extensively implicated.

From one to six cysts were observed in the *Cysticercus*-infected livers but the usual number was only one or two. *Hymenolepis diminuta* was much more frequent in its occurrence in the intestines than was *Hymenolepis nana*. The number of these worms present in each infection was not tabulated. Only one nematode species was seen in the intestine. In one rat 17 specimens of *Heterakis spumosa* were collected. *Trypanosoma lewisi* occurred much more frequently in the blood smears than did *Hepatozoon muris*.

Fifty-nine of the 200 rats examined were considered, on the basis of

TABLE I.  
Incidence of Parasites in Wild Rats, *Rattus norvegicus*.

Taxonomic Group	Name of parasite	59 young rats		141 adult rats		200 total	
		Positives	Per cent. infected	Positives	Per cent. infected	Positives	Per cent. infected
Protozoa	<i>Trypanosoma lewisi</i>	9	15.2	12	8.5	21	10.5
	<i>Hepatozoon muris</i>	0	0	4	2.8	4	2.0
Nematoda	<i>Capillaria hepatica</i>	18	30.5	129	91.5	147	73.5
	<i>Heterakis spumosa</i>	0	0	1	0.7	1	0.5
Cestoda	<i>Cysticercus fasciolaris</i>	5	8.4	30	21.2	35	17.5
	<i>Hymenolepis diminuta</i>	5	8.4	28	19.8	33	16.5
	<i>Hymenolepis nana</i>	3	5.0	6	4.2	9	4.5
Total number parasitized		28	47.4	133	94.3	161	80.5

their size, to be young animals. No parasites were found in 52.5% of the young rats, while only 5.6% of the adults were free of the forms observed in this study. The accompanying table shows the variations in the percentage of infection for each of the parasites in both adults and young. For the most part, there was a much higher prevalence of infection in the adults, due possibly to the longer period of susceptibility. The one exception to this was found in the prevalence of trypanosomes. In all other cases the present observations probably represent the complete prevalence of the parasites, while for *Trypanosoma lewisi* (and possibly *Hepatozoon* as well) the findings no doubt must be interpreted as the incidence, or recently infected animals. Animals once infected with *T. lewisi* develop an immunity to reinfection and, after the initial course of infection, trypanosomes may never be observed in a blood smear again. This would explain the higher apparent occurrence in the younger rats.

Careful record of the source of the rats within the park has been kept but as yet the number of rats is too small to show any significant variations of parasite infection in the rats from different areas. There is possibly a seasonal variation in the incidence of trypanosomes since most of the infections with this parasite were in the late summer months. However, this may be only apparent variation and could be more correctly explained by the fact that most of the younger rats were examined during this period. Andrews & White (1936) report the same seasonal and age variation with *T. lewisi* as found in the present survey. In regard to this finding they make the following statement: "This may be due directly to seasonal differences in transmission potential, indirectly to the inclusion of more young and susceptible rats as 'adults' in those seasons following the reproductive peak, or to both of these factors."

#### SUMMARY.

1. The occurrence of parasites in 200 rats (*Rattus norvegicus*) killed in the New York Zoological Park is tabulated.

2. *Capillaria hepatica* was the most frequently observed and occurred in 91.5% of the adults. The other parasites collected included *Trypanosoma lewisi*, *Hepatozoon muris*, *Heterakis spumosa*, *Cysticercus fasciolaris*, *Hymenolepis diminuta* and *Hymenolepis nana*.

3. Parasites were seen in adults much more frequently than in young rats. No parasites were found in 52.5% of the young rats, while only 5.6% of the adults were free from infection. There was a seasonal variation in the occurrence of *T. lewisi* and these parasites were more prevalent in the younger rats. No significant variation in the prevalence of parasites was recognized in rats from different areas within the park because of the small number examined thus far.

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